LINE SHAPES AND INTENSITIES OF CARBON MONOXIDE TRANSITIONS IN THE (3→0) AND (4→1) BANDS

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We have measured several carbon monoxide transitions in the (3→0) and (4→1) band using frequency stabilized cavity ringdown spectroscopy (FS-CRDS). The measured transitions are compared to the line strength values in HITRAN 2012 [1], those determined by Wojtewitz et al [2], and to theoretical calculations. The cavity length is actively locked to an iodine stabilized HeNe laser, providing long term frequency stability of 10 kHz and is linked to a self-referenced, octave-spanning frequency comb. The temperature of the optical cavity is actively regulated at the mK level, and the pressure measurements are SI-traceable. The sample is a NIST calibrated reference mixture of 11.98575(95)% CO in N_2. The absorption spectra are modeled using the Hartmann-Tran profile (HTP). The SNR in these spectra may exceed 10,000:1, which necessitates including the effects of speed dependence, collisional narrowing, and correlation between velocity-changing and dephasing collisions.

The relative uncertainties of the line strengths calculated in this study are better than 0.1%. There are systematic differences on the 1% level for ^{12}CO against both HITRAN [1] and the previous work by Wojtewitz et al [2]. The measurement uncertainties are nearly an order of magnitude lower than previous results. Additionally, the relative uncertainties in the integrated areas of selected ^{12}CO and ^{13}CO transitions are less than 0.006% and 0.02%, respectively, providing an excellent test case for determination of isotope ratios by direct use of theoretical line intensity calculations.

[1] Wojtewicz, S., et al., J Quant Spect and Rad Trans,2013. 130: p.191-200.
[2]Rothman, L.S., et al., Journal of Quant Spect and Rad Trans, 2013. 130: p. 4-50.